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FURTHER INVESTIGATIONS ON THE SEMEN OF THE BULL

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It is the object of this paper to present and discuss the results of investigations on the semen of the bull, in continuation and extension of work previously reported (Anderson, 1939, 1940). In particular, a more detailed examination of the semen of bulls of known fertility and of bulls in the early stages of epididymitis has been made.

Material and Methods

The semen was collected, as in artificial insemination, with the artificial vagina, following the method of Walton and Russian workers. This method has already been described in full (Anderson, 1938, 1940). For storage, semen was placed in pyrex test tubes, the tube filled with liquid paraffin (Walton, 1936), corked and sealed with candle wax. It was then wrapped in cotton wool and placed in a thermos flask at a temperature of 7° to 10° C. The maintenance of the temperature in the flask was best accomplished by keeping the flask in a refrigerator.

The general classification of the bulls investigated is given in Table I. For convenience, bulls classed under sperm "good" are subdivided into (*a*) E.S.—Experimental Station bulls, (*b*) Farm A bulls and (*c*) Other bulls. The bulls on the Experimental Station were pure-breds except for one grade Ayrshire (Ag). Those on Farm A were Friesians, mostly pure-breds. The other Experimental Station bulls are designated thus: H = Hereford, Su = Sussex, AA = Aberdeen-Angus, A2 = Ayrshire and F = Friesian.

TABLE I

SUMMARY OF BULLS, 1938-1939

Classification	Sperm tests	Clinical examination only	Total
Clinically normal			
Sperm good ...	51	—	51
Sperm poor ...	16	—	16
Sperm not examined ...	—	6	6
Clinically abnormal			
Epididymitis ...	9	8	17
Testicle abnormal	5	2	7
Total ...	81	16	97

SEMEN EXAMINATION

Volume.—The volume of ejaculates in the different classes of bulls is shown in Table II (*over-leaf*). In general there was a tendency for the mean volume to decrease from normal to abnormal bulls, but there was no hard and fast line between the different classes. Much of the variation was no doubt due to individual differences and possibly age, management and feeding. It has already been noted that the ejaculate of young bulls is smaller than that of adult bulls. The ejaculate in cases of epididymitis is often as large as that from fertile bulls and one bull (Sk.) with bilateral enlargement of the testes, had on the average, an ejaculate of normal size, though the variation in size of the ejaculate was greater than is usually found (Table II).

Spermatozoa occupy but a small part of a total ejaculate, the bulk of which is formed by the accessory secretions. Therefore the volume of the ejaculate may be regarded more as an indication of secretory activity of the accessory glands than of the testes. The degree of involvement of the accessory glands in abnormal conditions may be suspected from the size of the ejaculate. The primary cause of absence of spermatozoa from the ejaculate in cases of epididymitis is occlusion of the epididymal ducts. This can occur without causing much change in the volume of the ejaculate, *e.g.*, three bulls with epididymitis that were still ejaculating small quantities of spermatozoa, had an average ejaculate of 3·3 mls. while six other bulls also with epididymitis, but which ejaculated no spermatozoa, had an average volume of 2·9 mls.

The three Experimental Station bulls of the beef type, Hereford, Sussex and Aberdeen-Angus had smaller ejaculates than the dairy types. Indications of possible breed differences have already been noted. The mean volume of the ejaculates of five of these bulls was very similar in the two periods, 1935-37 and 1938-39; there was a slight decrease in the mean volume of the ejaculates of all bulls with the exception of A2. The grade Ayrshire bull (Ag) had the largest mean volume of ejaculate in both periods and a Shorthorn grade bull (S1) had the next largest average ejaculate (5·94 mls.) in the period 1935-37.

Seasonal changes in the volume of ejaculates of those bulls (Ag, A2, H, Su and AA1) which performed most services during 1938 and 1939 are shown in Table VII and Fig. 1. The data in Fig. 1 are smoothed by the formula $\frac{a + 2b + c}{4}$ (where "b" is the particular month and "a" and "c" the preceding and following months). These data are presented without comment, since investigations of seasonal changes would require more controlled conditions than was possible or attempted in the period under review.

TABLE II

Volume of Ejaculates

Classification	Number of Bulls	Number of Ejacula	Volume in mls. Mean	S.D.
Clinically normal				
Sperm good (*a*) E.S.	6	241	4·40 ± 0·13	2·1
(*b*) A	10	27	3·8	
(*c*) Others	30	60	3·22 ± 0·20	1·5
Sperm poor	16	27	3·2	
Clinically abnormal				
Epididymitis	9	15	3·2	
Testicle abnormal	1 (SK)	51	5·45 ± 0·45	3·2
	4	9	2·7	

Experimental Station

Bull	1938-1939 Number of Ejacula	Mean	S.D.	1935-1937 Number of Ejacula	Mean	S.D.
H	72	3·65 ± 0·20	1·71	9	3·7	
Sul	36	3·24 ± 0·30	1·75	10	3·7	
AA	49	3·65 ± 0·27	1·89	9	5·8	
Ag	39	5·81 ± 0·37	2·32	25	6·77 ± 0·37	1·3
A2	35	5·66 ± 0·31	1·87	18	5·4	
F	10	6·05	—	—	—	

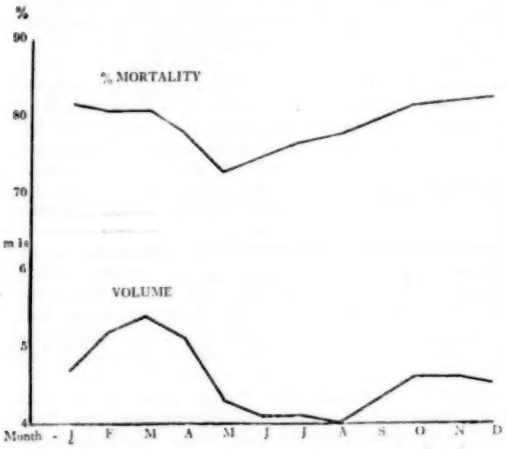

FIG. 1—Seasonal Variation in Motility and Volume of Ejaculates.

Density of Spermatozoa.—The concentration per c.mm. and the total number of spermatozoa per ejaculate are shown in Table III. Spermatozoa were absent from eleven ejaculates from six bulls with epididymitis and three other bulls with epididymitis had ejaculates containing an average of 227,000 spermatozoa per c.mm. Counts were made on five bulls with testicular abnormalities; of these, one, with a very small right testis, had an average of 132,000 spermatozoa per c.mm. in five specimens, and another (SK) which had bilateral enlargement of both testes had an average of 539,000 spermatozoa per c.mm. For the 53 specimens from 29 bulls with "good" sperm, the number of spermatozoa in thousands was 748,000 ± 52,500 (s = 395,000). Three (5·3 per cent.) specimens had a count below 250,000 spermatozoa per c.mm. and 15 specimens (26·3 per cent.) below 500,000 per c.mm.

For 29 bulls with sperm "good," the mean total number of spermatozoa per ejaculate in thousand millions was 4·04 ± 0·14 (s = 2·79). In the three bulls with epididymitis that ejaculated spermatozoa the total count was 0·683 per ejaculate; for all bulls with epididymitis, however, the average was 0·146 per

TABLE III

Concentration of Spermatozoa

Classification	Number of Bulls	Spermatozoa Number per c.mm. in thousands Mean	Range	Percentage abnormal
Clinically normal				
Sperm good (*a*) E.S.	6	944	320-1, 227 (18)	10·5 (10)
(*b*) A	10	716	60-1, 133 (26)	6·9 (19)
(*c*) Others	13	705	430-1, 530 (13)	10·6 (22)
Sperm poor	16	512	50-1, 270 (13)	16·3 (8)
Clinically abnormal				
Epididymitis	9	49	0-340 (14)	55·5 (2)
Testicle abnormal	5	370	110-580 (12)	25·0 (7)

Figures in parenthesis indicate number of ejaculates.

ejaculate. In the bull with the very small right testis the total count was 0·324 and in the bull (Sk) with bilateral enlargement of the testes it was 3,261 thousand millions per ejaculate. Individual results on the concentration of spermatozoa per c.mm. and the total number per ejaculate are too few to detail here; they are mentioned later in connection with fertility.

Motility.—Particulars of the motility of the ejaculates of the different classes of bulls are shown in Table IV (10 = 100 per cent. activity, 9 = 90 per cent. activity, etc.). Since 70 per cent. motility is taken as the permissible limit for artificial insemination, it is of interest to note the number of specimens which showed 70 per cent. or greater motility. In the three classes of bulls, Experimental Station, Farm A and "others," on which the bulls produced "good" sperm there were 88·5, 66·7 and 76·6 per cent. of ejaculates respectively with this motility. For bulls with sperm "poor" the figure was 14·7 per cent.; for bulls with atrophy of the testes 25·0 per cent., and for hypertrophy of the testes 6·7 per cent., and for cases of epididymitis, none.

Abnormal Spermatozoa.—A few estimations of abnormal types of spermatozoa in the Experimental Station bulls gave an average of 10·5 per cent. with a range of from 4 to 16 per cent. For Farm A bulls, the average was 6·5 per cent. with a range of from 3 to 10 per cent. For other clinically normal bulls with "good" sperm the average was 10·6 per cent. and the range 4 to 20 per cent. The 16 clinically normal bulls with poor sperm had, with the exception of one bull, either poor motility or small concentration of spermatozoa or both. This one bull had good motility (80 per cent.), but 44 per cent. of spermatozoa were abnormal and the number of spermatozoa per c.mm. (490,000) was also rather low. Two cases of epididymitis had 25 per cent. and 86 per cent. of abnormal spermatozoa. Two bulls with both testes which are shown in Table VII and Fig. 1. It is of interest to note, however, that of 22 sperm specimens of poor motility collected during 1938 and 1939 from the Experimental Station bulls, 14 were collected during the months of May, June and July.

Table IV—Motility

Classification	Number of Bulls	Number of Specimens	Motility 10	9	8	7	6	5	4	3	2	1	N	A	Mean Motility
Clinically normal															
Sperm good (*a*) E.S.	6	254	10	76	121	18	9	4	3	3	6		3	1	78
(*b*) A	10	27	1	7	4	6	4	4				1			69
(*c*) Others ...	30	52	2	17	13	8	6	4	1	1					76
Sperm poor	16	27			3	1	2	6	4	3	2	3	3		39
Clinically abnormal															
Epididymitis	9	14										3		11	
Hypertrophy of testis	1 (SK)	51				4	4	5	11	5	9	9	4		37
Atrophy	1	5					2		2	1					
	2	3				2							1		48

Bull	Number of Specimens	Experimental Station Motility 10	9	8	7	6	5	4	3	2	1	N	A	Mean Motility	70 per cent. and over
H	73		29	36	4	2	2							82	86
A2	41	4	14	13	2	2				5			1	75	82
Ag	42	2	11	21	3		1	1	1			2		76	83
AA1	51	1	6	30	8	2	1	1	1	1				76	80
Su1	36	2	8	19	1	3		1	1			1		77	84
F	11	1	8	2										89	89
Total	254	10	76	121	18	9	4	3	3	6		3	1	78	89

N = No motility; A = spermatozoa absent.

The motility figures for individual bulls on the Experimental Station and Farm "A" are for all the ejaculates from these bulls for the period 1938-39. Occasionally, motility on the first ejaculation was poorer than on the second or third ejaculations, but there were few occasions on which second ejaculations had to be collected because of poor quality of the first ejaculation (Table V). The figures given may therefore be taken as representative of the motility of sperm of the different bulls. In bulls classed under sperm "poor," eight bulls on a single ejaculation gave sperm of poor motility; had a second collection been obtained from these bulls, it is possible that ejaculates showing better motility might have been obtained.

The remarks made about seasonal variation and volume of ejaculates apply also to motility, data for enlarged had 19 per cent. (bull Sk.) and 30 per cent. respectively. The mean percentage of abnormal spermatozoa for all testicular abnormalities detected was 25 per cent. Clinical changes in the testes and epididymes were therefore in most cases associated with an increase in the percentage of abnormal spermatozoa, which agrees with previous observations.

Frequency of Collection

The effect of the frequency of collection can be examined in two groups, (*a*) in which there was an interval of minutes between collections of sperm and (*b*) in which there was an interval of days.

Most workers have observed that the first ejaculation in normal fertile bulls may be of inferior quality to subsequent ejaculations. A comparison between first,

second and third ejaculations is shown in Table V. In clinically normal bulls, the volume and motility improved on the second jump. Even in bulls with sperm "poor" there was some improvement in motility on the second ejaculation. In the bull with bilateral hypertrophy (Sk.) of the testes, there was a decrease in volume from the first to the third ejaculation; while the motility, which was poor in all jumps, increased slightly on the second ejaculation but was practically absent in the third.

On 24 occasions double jumps were obtained from the Experimental Station bulls during 1938 and 1939 (Table V). On four of these double jumps the motility was good enough (70 per cent.) on the first collection to use the sperm for artificial insemination. Therefore, on only 20 occasions was it necessary to collect a second specimen of sperm because of poor quality of the first ejaculate, *i.e.*, in about 8 per cent. of ejaculates. In four specimens from different bulls, the volume and motility were less on the second jump, but in most cases they were better.

The number of days between ejaculations had little or no effect on either motility or volume of the ejaculate (Table VI). There was a slight decrease in motility and increase in volume as the interval increased from 1 to 20 days, but this tendency was not maintained for longer intervals. At the first ejaculation after quite lengthy intervals the volume and motility have been good. In one bull, for example (Ag) the first collection after an interval of seven months was 80 per cent. motile.

It is a plausible theory that a too lengthy interval between ejaculations is responsible for poor quality of sperm in the subsequent ejaculation, on the grounds that spermatozoa are continually being produced, which if not ejaculated, undergo degeneration and are eliminated at the next ejaculation. In the present data there is no relationship between poor quality of sperm and interval since last collection of sperm or frequency of collections.

Table VI

Frequency of Ejaculation

Interval in days between Ejaculations	Number of Ejaculations	Mean per cent. Motility	Mean Volume in mls.
1 to 5	75	83	4·6
6 to 10	64	79	4·5
11 to 15	26	76	4·9
16 to 20	13	74	5·5
21 to 25	5	80	5·5
26 to 30	9	72	5·3
31 to 35	1	90	7·0
36 to 40	1	30	5·0
41 to 45	3	80	6·0
46 to 50	1	90	5·0
51 to 55	—	—	—
56 to 60	3	80	4·7

Table VII

Monthly Variation in Ejaculates

	Number of Ejaculations	Mean per cent. Motility	Mean Volume in mls.
January	9	82	4·4
February ...	12	80	5·3
March	16	82	5·6
April	19	80	5·3
May	18	69	4·1
June	28	76	3·8
July	24	78	4·5
August	22	75	3·7
September ...	23	84	4·2
October ...	13	80	4·9
November ...	21	84	4·4
December ...	11	82	4·6

Table V

Comparison Between First and Subsequent Ejaculates

Classification	Number of Bulls	Number of Repeated Ejaculates	Volume in mls. 1st	Volume in mls. 2nd	Volume in mls. 3rd	Motility 1st	Motility 2nd	Motility 3rd
Clinically normal								
Sperm good (*a*) E.S.	6	24	3·3	4·0	—	53	75	—
(*b*) Others	8	8	2·8	3·7	2·7	69	80	84
Sperm poor	7	7	2·4	2·4	—	37	50	—
Testicular abnormality	1 (SK)	19	6·9	5·7	1·2	25	39	6
Epididymitis	4	4	2·1	2·1	2·8	R	R	N

Experimental Station

Bull	Total number of Ejaculates	Number of Repeated Ejaculates	Volume in mls. 1st	Volume in mls. 2nd	Motility 1st	Motility 2nd
H	85	8	3·1	3·8	70	80
Su1	59	3	2·2	3·0	30	90
AA1	61	3	4·0	5·5	60	70
F	11	1	7·0	7·0	90	90
A2	71	6	4·1	5·4	30	60
Ag	74	3	4·6	6·0	40	60
		24	3·3	4·0	53	75

XUM

Clinically Normal Bulls

The general characteristics of sperm from the different classes of bulls is summarised in Table VIII. In bulls with "good" sperm the figures for volume, motility, concentration and total number of spermatozoa and percentage of abnormal spermatozoa are such as are associated with fertility. Some of the Experimental Station bulls have been under observation for over four years and have consistently produced sperm of high quality during this time.

Table VIII—General

Classification	Mean volume of Ejaculate in mls.	Mean per cent. Motility	Mean number of Spermatozoa in thousands per c.mm.	Mean per cent. abnormal Spermatozoa
Clinically normal				
Sperm good (*a*) E.S.	4·40	78	944	10·5
(*b*) A	3·80	69	716	6·9
(*c*) Others	3·22	76	705	10·6
Sperm poor	3·20	39	512	16·3
Clinically abnormal				
Epididymitis	3·20	—	49	55·5
Testicular hypertrophy	2·40	32	539	23·0
atrophy	2·84	48	132	29·2

In bulls with "poor" sperm, on the average, motility, concentration and total number of spermatozoa were reduced and the percentage of abnormal spermatozoa was increased. In 11 of the 16 bulls in this class the motility was less than normal. In one bull there was a high percentage of abnormal spermatozoa (44) and the concentration and total number of spermatozoa (490,000 per c.mm. and 245 millions respectively) were below normal; the motility on two consecutive collections was 50 per cent. and 80 per cent. This was a young bull which had had very few services. In four bulls there was both poor motility and a concentration of less than 300,000 spermatozoa per c.mm. It is clear that an ejaculate may be normal in respect of, say, motility and below normal for other criteria such as concentration of spermatozoa and number of abnormal spermatozoa.

Clinically Abnormal Bulls

In most cases of epididymitis there was a complete absence of spermatozoa, but when they were present in the ejaculate they were few in number, of poor motility and many abnormal forms were observed. Similar observations have been reported previously (Anderson, 1939, 1940).

One natural question that arises is the effect of unilateral epididymitis on the sperm. Of a total of 12 bulls with unilateral epididymitis observed from 1936 to 1939, seven ejaculated no spermatozoa and the ejaculates of the five other bulls contained few spermatozoa which exhibited no motility or feeble motility. The ejaculate of one of these five bulls contained 240,000 spermatozoa per c.mm. and 25 per cent. abnormal spermatozoa. The sperm picture was thus the same in unilateral as in bilateral epididymitis. It is obvious that functional disturbances must arise before gross clinical changes can be detected. This is supported by five cases observed during the course of the disease. Two of these bulls were tested during 1936 and 1937 and both had azoospermia before clinical signs of epididymitis were found.

One case of epididymitis was observed in the initial stages. This bull (S), a pure-bred Friesian, aged 22 months, had only three natural services between October 10th and November 2nd, 1937, the only services since the bull arrived in Kenya. Two of these services were fertile. On January 1st, 1938, no spermatozoa were present in his ejaculate which contained thick, yellow, stringy mucus. On four other occasions up to March 10th he gave similar ejaculates. On February 22nd no clinical evidence of epididymitis could be detected, but on April 20th he had marked epididymitis. The history of this bull is of particular interest, as one of the cows (x) served by him on October 25th, which failed to conceive, had been served previously on September 18th and October 9th by another bull (T) which was found to have epididymitis when examined on November 4th. This same cow (x) was served later, in January and February, 1938 by a grade bull (U) which subsequently developed epididymitis. It is as a rule difficult to obtain a clear history of the course of infection in a herd and the author is therefore particularly indebted to Mr. Byng-Hall, of Soysambu Estate, for the details of this case. It appears that the cow (x) was infected by bull (T) at service on September 18th or October 9th and then passed on the infection to bull (S) on October 25th and to bull (U) in January or February, 1938. The cow was thus in a known infective condition for about four months from September to January. The bull (S) developed clinical signs of epididymitis in 58 days between February 22nd and April 20th; such signs might have been detected at an earlier date, if the bull had been examined. There was a period of 82 days between the probable date of infection and the date on which his sperm was first examined and found to be poor. It is of interest to note that this bull successfully impregnated a cow eight days after contracting infection.

In May, 1938, the ejaculate of a pure-bred Ayrshire bull contained only 100,000 spermatozoa per c.mm., which were sluggishly active, and in which there was a high percentage of abnormal spermatozoa. The ejaculate was creamy in consistency but on dilution it showed floccules. Many large epithelial cells were present. Clinically, the epididymes were normal on this date, but by August, 1938, there was marked epididymitis on both sides. The author is indebted to Mr. Beaumont, M.R.C.V.S. for particulars of another

bull which gave poor sperm when first tested and which about six weeks later showed the first signs of epididymitis.

From a consideration of these cases it is clear that sperm production is seriously affected before any clinical evidence of the disease can be detected. From clinical evidence with infrequent examinations it is not possible to say how long it takes for sperm to become altered after infection, how quickly clinical symptoms develop, or how long sperm may be altered before clinical symptoms develop. No doubt there is some variation according to severity of infection and individuality of the bulls. The most exact information available so far is from bull S, which ejaculated poor sperm and showed clinical symptoms 82 days and 177 days respectively after the date of probable infection. The sperm was poor for a period of 95 days before the bull was found to be clinically affected. Clinical symptoms may develop in a short time as, for example, in Mr. Beaumont's case in which this apparently happened in a few weeks.

Testis.—During the whole period 1936 to 1939 there were eight bulls in which definite clinical abnormalities were observed in the testes. In four of these bulls the testes were enlarged. From two bulls with unilateral enlargement of the testes, the ejaculates contained (*a*) no spermatozoa and (*b*) spermatozoa of poor motility (10 to 20 per cent.). Two other bulls with both testes enlarged produced ejaculates of poor motility; the ejaculate of one of these bulls contained few spermatozoa, of which a high percentage were abnormal and the other bull (Sk.) produced poor sperm over a period of nearly three years.

Of three bulls with unilateral atrophy of the testis, two produced dead sperm, one with 52 per cent. abnormal types, and the ejaculate of the other bull was of poor motility and contained a low concentration of spermatozoa, 132,000 per c.mm. Another bull with both testes small, ejaculated no spermatozoa. A further two bulls in which one testis was thought to be rather small ejaculated sperm of normal motility, though one had 20 per cent. abnormal spermatozoa. It may therefore be concluded that, when the testes appear to be markedly abnormal on clinical examination, it is likely that the sperm is also abnormal.

Character of Semen and Fertility

Sperm tests were made on a number of bulls whose breeding histories at the time of the tests were known. It is convenient to consider these bulls in two groups (*a*) those for which one or more sperm tests were made during a period for which their actual fertility is known, and (*b*) those whose sperm was used solely for artificial insemination and for which the characters of every ejaculate used were known.

Group A. *Sterile Bulls.*—The 15 bulls with clinical epididymitis present no difficulties for none of them ejaculated spermatozoa. The development of this condition has already been discussed. The quality of the sperm becomes affected some time before clinical symptoms develop and it is therefore highly probable that a bull becomes sterile before the disease is clinically evident. On the other hand, a bull may be fertile for a certain period after infection, as bull S shows.

The Ayrshire bull SK. (particulars of sperm are given earlier in this paper) which has both testes enlarged, was sterile at the time of the first test nearly three years ago. It has produced poor sperm ever since and although its fertility has not been tested during this period, it is considered extremely unlikely that it was capable of getting, at the most, more than a very small percentage of calves. The conjunction of poor sperm and clinical symptoms gave this bull a poor prognosis, when first examined, which has not altered after a long period of observation and testing.

A single collection from one bull (80) in June, 1938, was 80 per cent. actively motile when collected, but was dead after storage for 24 hours. The ejaculate contained 320,000 spermatozoa per c.mm. and a total of 1,312 million spermatozoa. The percentage of abnormal spermatozoa was 13·0. From March to July, 1938, this bull had eleven services of which none was fertile, but in August two out of four services were fertile. The only comment that can be made on this bull is that the number of spermatozoa in the ejaculate was below normal.

Fertile Bulls.—The sperm of the eleven fertile bulls (bulls on Farm A) showed on the average a high density of spermatozoa with good motility and a low percentage of abnormal spermatozoa (Table IX). A few ejaculates from these bulls were of small volume, poor motility and contained a small number of spermatozoa. These were all from single jumps and second ejaculates could not be obtained because the bulls were unwilling to ejaculate again. The low figures in the range for number of spermatozoa per c.mm. and total number of spermatozoa per ejaculate may therefore not be quite typical of the bulls. Because a fertile bull may ejaculate sperm of poor quality on the first collection, the necessity for obtaining two or more ejaculates when the first is bad, is emphasised. No differences could be detected in the sperm to account for the variation in the fertility of these bulls.

Group B.—The data in this group refer to the Experimental Station bulls which were used solely for artificial insemination for the period January, 1936, to August, 1939. The calving percentage for this period, when artificial insemination was the sole breeding method, was 85 per cent. The number of inseminations required for conception varied from 1·18 (bull F) to 2·71 (bull A3), with an average of 1·79 (Anderson, 1941).

The estimation of the quality of the sperm was, in the majority of cases, based on motility and density, and from time to time, haemocytometer counts were made to determine the exact number of spermatozoa per c.mm. and the total number of spermatozoa per ejaculate, and counts were also made of the number of abnormal spermatozoa. The general features of the ejaculates, according to the number of services required per conception, are summarised in Table IX; these data are given in more detail earlier in the paper. The general features of the ejaculates of these bulls were: volume 4 to 5 mls., motility 80 to 90 per cent; number of spermatozoa per c.mm. 800 to 900 thousand; total number of spermatozoa per ejaculate about 5,000 million and the percentage of abnormal spermatozoa about 10 per cent.

Within the above range of fertility none of the criteria used was of much value for indicating differences in fertility. The data for the two bulls with 1·18 and 2·71 services per conception are, however, few in number and examination of the two other groups with 1·5 to 2·0 and 2·1 to 2·5 services per conception shows certain minor differences (Table IX), but apart

TABLE IX

CHARACTER OF SEMEN AND FERTILITY

Group A	Services per Conception 1·51-2·00	2·01-2·50	2·51-3·00	3·01-3·50
Number of bulls	3	4	3	1
Number of services	28	174	21	31
Number of ejaculates	6	18	7	5
Volume, mean, in mls.	3·9	3·9	3·9	4·5
Percentage motility on collection	60	75	73	74
Percentage motility after 24 hours	36	13	20	17
Percentage of ejaculates with motility below 70 per cent. on collection	22	26	43	20
Concentration of spermatozoa. Number in thousands per c.mm. :				
(*a*) mean	667	656	893	460
(*b*) range	330–1140	490–1130	390–1180	290–640
Total number in ejaculate in millions :—				
(*a*) mean	2920	2448	3570	1683
(*b*) range	759–6786	1100–6650	616–9126	870–2496
Percentage abnormal spermatozoa	6·3	8·0	6·0	9·0

Group B	1·01-1·50	1·51-2·00	2·01-2·50	2·51-3·00
Number of bulls	1	3	3	1
Number of services	20	336	127	19
Number of ejaculates	11	258	204	11
Volume, mean, in mls.	6·05	4·32	5·04	5·50
Percentage motility, mean	90	87	80	93
Percentage ejaculates below 70 per cent. motility	0	5·4	10·3	0
Mean percentage motility of sperm stored for				
(*a*) 24 hours	68 (8)	72 (46)	66 (54)	—
(*b*) 48 „	55	56	43	
(*c*) 72 „	34	30	22	
Concentration of spermatozoa. Number in thousands per c.mm. :				
(*a*) mean	460 (1)	844 (6)	936 (24)	—
(*b*) range		320-1875	431-2010	
Total number in millions per ejaculate :				
(*a*) mean		6313	4970	
(*b*) range		1700-15000	1160-11055	
Percentage abnormal spermatozoa :				
a) mean	2·0 (1)	9·9 (8)	11·1 (11)	
(*b*) range		6-14	5-18	

Figures in parentheses indicate number of ejaculates.

from these rather insignificant differences, it seems more important to regard this group of eight bulls as of fertility ranging from 1·18 to 2·71 services per conception with a mean of 1·79, and to examine the ejaculates more particularly for the range of variation that occurs in the different criteria.

Data on the volume of the ejaculates of the different bulls are given in Table II. The mean volume of the ejaculates for the two other bulls was : bull Sl. 5·3 mls. (71 ejaculates) and bull A3 5·5 mls. (11 ejaculates). The range of variation for all ejaculates from the eight bulls was 1·5 mls. to 12·0 mls.

The range of variation in motility is shown in Table IV. Thirty-five ejaculates (7·2 per cent.) had a motility of less than 70 per cent. When the first ejaculate was of poor motility (less than 70 per cent.), the second ejaculate was usually better, but in several instances the second ejaculate showed no improvement over the first. It has been observed lately that a bull may ejaculate two specimens of poor motility and yet the third specimen may be of good motility. It is therefore necessary to recognise that a certain number of ejaculates from fertile bulls may be of poor motility, but that when motility is poor on the first ejaculation it tends to improve on repeated ejaculation.

Similarly with the concentration of spermatozoa. Out of 484 ejaculates, two ejaculates (one from bull H and one from bull A2) contained no spermatozoa. The specimen from bull H was a single ejaculate, that from bull A2 was the first ejaculate and the second was a good dense specimen of high motility.

In addition to this general analysis a closer examination of the relationship between the quality of the semen and fertility can be made by examining the ejaculates actually used for insemination. No ejaculates were used for insemination which showed a motility of less than 70 per cent. There was no difference in fertility when the motility varied from 70 to 100 per cent. (Table X *over-leaf*). Donham, Simms and Shaw (1931), who collected sperm from the vagina of the cow found a correlation between motility and fertility.

It was thought at one time that the keeping quality of sperm might give an indication of its fertilising capacity (Anderson, 1939), but it now appears that this is not so (Table XI (*over-leaf*)). No correlation was

Table X

Motility and Fertility

Per cent. Motility	Inseminations Number	Per cent. Fertile
10	212	49·1
9	131	59·5
8	119	54·6
7	23	43·5
Mean 93	485	53·0

number, regarded arbitrarily as of reduced fertility, because their sperm was below normal in one or other respect, ejaculates of motility of 70 per cent. and over had an average of 18·8 per cent. of abnormal spermatozoa (range 3 to 31); ejaculates of motility of less than 70 per cent. had an average of 11·2 per cent. of abnormal spermatozoa (range 4 to 30). Three of the seven bulls whose ejaculates were of good motility (70 per cent. and over) had 20 per cent. or more abnormal spermatozoa and one of the eight bulls whose sperm was of poor motility (below 70 per cent.) had 30 per cent. abnormal spermatozoa. Thus, bulls whose ejaculates are of good motility may contain a high percentage of abnormal spermatozoa and bulls whose ejaculates are of low motility may contain only a small percentage of abnormal spermatozoa.

Table XI

Fertility of Fresh Sperm and Motility of Stored Sperm

Inseminations No.	Per cent. Fertile	Per cent. Motility at 24 Hours	Inseminations No.	Per cent. Fertile	Per cent. Motility at 24 Hours	Inseminations No.	Per cent. Fertile	Per cent. Motility at 72 Hours
16	43·8	90 to 100	2	0	90 to 100	3	66·6	90 to 100
52	50·0	70 to 80	18	38·9	70 to 80	3	66·6	70 to 80
7	71·4	50 to 60	39	56·4	50 to 60	24	41·7	50 to 60
3	33·3	30 to 40	9	66·6	30 to 40	17	47·1	30 to 40
—	—	—	1	0	10 to 20	3	66·6	10 to 20
—	—	—	—	—	—	20	60·0	N

found between the fertility from insemination with fresh sperm and the motility of this sperm after storage for 24 to 96 hours. The spermatozoa counts made on ejaculates used for insemination are too few for an examination of the relation between sperm density and fertility.

The general conclusion is that none of the criteria used was adequate to determine small differences in grades of fertility. Edwards and Walton (1939) came to a similar conclusion. On the other hand, a type of sperm with certain general features, which can readily be recognised, is associated with fertility. A corollary is that semen from certain bulls may show a wide variation in certain characteristics. Such cases, however, appear to be relatively few in number and their significance can be better judged if a number of ejaculates are examined.

General.—It is of interest to examine, carefully, those cases in which sperm is judged as good, by certain criteria and as poor, by others. In the first place are those bulls whose sperm may be judged as perfectly normal by all available criteria, yet whose fertility is low and there may be a high incidence of abortions following their services. Williams, W. W. (1920) mentions several such cases. Lagerlöf (1934) described a sterile bull (No. 86) whose ejaculates were perfectly normal in respect of number of spermatozoa, motility and percentages of abnormal and immature spermatozoa, but they contained streptococci. Such cases are probably exceptional. They do not invalidate the available criteria for evaluation of sperm, but because of them it is necessary to recognise that fertility cannot be guaranteed from sperm examination.

In the previous series of sperm examinations (Anderson, 1939, 1940) it was found that the ejaculates of eleven bulls with epididymitis, which showed either no motility or motility of 10 to 20 per cent., contained a percentage of abnormal spermatozoa ranging from 4 to 66. In these cases, motility was a better guide than morphology. In another class of bull, 15 in

Lagerlöf (1934) has published detailed accounts of semen examinations from bulls whose breeding history at the time of the examination was known. A critical examination of his data permits an interesting comparison on the value of the different indices. Thus, in nine sterile bulls with hypoplasia of the testes, spermatozoa were few or absent, the percentage of abnormal and immature spermatozoa was high; the motility was less than normal, except in one bull in which it was classed as "good." This bull had an average of 115,000 spermatozoa per c.mm. Thus at least eight of these nine bulls could have been classified on sperm density and motility as well as on morphology of the spermatozoa. In bulls with degenerative changes in the testes, however, there were two bulls (Nos. 15 and 36) in which the density and motility were normal, but the percentage of abnormal spermatozoa was high. One of these bulls was of poor fertility and the other was sterile. Another bull (No. 56), similarly affected, had a normal density of spermatozoa, but poor motility and a high percentage of abnormal spermatozoa. One bull (No. 8) with *abortus* orchitis had almost a normal concentration of spermatozoa (650,000 per c.mm.), few abnormal types of spermatozoa, but the motility was almost nil. Generally, there was a correlation between the density of the spermatozoa, the percentage of abnormal spermatozoa and the motility, but this association did not hold in every case, as the above examples show.

Practical Consideration

When widespread sterility occurs in bulls, as it does in Kenya, a demand arises to have the fertility of bulls tested, either in connection with suspected sterility on a particular farm or in connection with the purchase of bulls. The question naturally arises, to what extent is it possible to-day to determine with any accuracy the fertility of a male animal?

Fertility in the bull may be estimated from (1) previous breeding records, (2) clinical examination of the genital organs, and (3) examination of the semen. Breeding records refer to the past history of an animal and are therefore of value only for that purpose. When based on calvings they refer to a period ante-dated by at least nine months. A bull sterile to-day, may have been of normal fertility nine months ago. A closer estimate may be attempted by basing fertility on cows "holding," but even if this method were sufficiently accurate, there is still an intervening period during which fertility may have become affected. Bull S provides an example of the rapidity with which a bull may become sterile.

Clinical examination of the genital organs is a useful adjunct only. It is possible to detect changes in the size, shape and consistency of the testes, epididymes and in some cases in the seminal vesicles, and such abnormalities are probably associated with alteration in fertility, but sterile bulls and bulls of low fertility may have, as far as can be detected clinically, perfectly normal genital organs. It is therefore on the examination of the semen that judgment must be based. Much valuable work has been done on this subject in recent years and it is possible to identify a characteristic type of semen with fertility, sterility or with "reduced" or "doubtful" fertility. Milovanov (1936) has summarised the views of workers on the evaluation of the sperm of fertile sires and the author's results are very similar. The extreme cases of sperm evaluation are those, (*a*) in which the ejaculate is useless for impregnation, since it contains either no spermatozoa or only dead spermatozoa and (*b*) in which the ejaculate, examined by all the available criteria, is "good" and conforms with that of fertile bulls. In the latter class of ejaculate it is not yet possible to identify a particular type of ejaculate, nor an ejaculate showing certain features, with a particular degree of fertility. None of the criteria commonly used for evaluation of sperm is adequate for this purpose. The most promising approach to this problem is the work of Edwards and Walton (1939) who have found a relationship between the "respiration rate" of sperm and the number of services required for conception.

With the intermediate types of sperm the position is by no means clear. A particular ejaculate may fail in respect of one or more criteria and is therefore regarded as below the standard normally associated with fertility. When the concentration of spermatozoa is low, the motility very poor and the percentage of abnormal spermatozoa high it is likely that the fertility is low or even absent. It does not, however, appear possible at present to draw a hard and fast line between fertility and sterility on the basis of sperm examinations.

A point to be decided is whether or not a particular ejaculate can be regarded as typical of a bull. This is of particular importance when a bull is unwilling to ejaculate more than once when tested. When a single ejaculate, judged by available criteria, is classed as "good," the bull can probably be regarded as fertile, but a poor ejaculate does not by any means condemn the bull. Several instances have been noted in which a very poor ejaculate has been obtained from fertile bulls. In such cases, if possible, two or more ejaculates should be obtained. If the sperm is now good, the bull can probably be regarded as fertile, but if there is no improvement, or the sperm is worse, the bull is regarded as doubtful. In such cases repeated tests at, say, monthly intervals should be made to determine if the bull is improving or deteriorating. Some bulls may temporarily produce poor or bad sperm but in time return to normal ejaculates. Lagerlöf (1934) mentions two bulls which required two to three months for the sperm to return to normal. The extent to which this is possible will depend on the degree of involvement of the testes and accessory reproductive organs. When the ejaculates are poor a clinical examination of the genital organs may aid diagnosis and prognosis.

Summary

An account of the examination of the semen of clinically normal and abnormal bulls in Kenya is given. The sperm characteristics of bulls whose breeding history was known at the time of examination are discussed.

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PEMBROKESHIRE FARMERS AND THE TUBERCULOSIS ORDER

Mr. H. M. Duff, Divisional Veterinary Inspector of the Ministry of Agriculture, informed Pembrokeshire County Council Contagious Diseases Committee at Haverfordwest recently that the veterinary inspector in charge of the slaughterhouse at Cardiff had written complaining of the number of cases of tuberculosis in cows sent to the city from Pembrokeshire.

Apparently, he said, as a result of the Ministry of Food organisation, a number of cows had been rejected. The inspector at Cardiff was very alarmed at the number of these cases, and he (Mr. Duff) suggested that action should be taken to stimulate farmers to report all cases of tuberculosis.

In reply to the Chairman (Major C. Barclay) Mr. Duff said that the cases were worse than mere reactors. They were very thin cows which were coughing. Where a cow was emaciated and thin and had a cough it was the duty of the farmer to report the matter.

"Generally in the county," said Mr. Duff, "they had been able to pride themselves on the freedom from tuberculosis of tuberculin tested herds."

It was decided to draw the attention of farmers to the Tuberculosis Order.

* * * * *

Weekly Wisdom

He that knows not, and knows not that he knows not—
He is a fool; shun him.
He that knows not, and knows that he knows not—
He is good material; teach him.
He that knows, and knows not that he knows—
He is asleep; wake him.
He that knows, and knows that he knows—
Let him watch his prosperity.

—Arab saying.

THE VETERINARY RECORD

April 5th, 1941.

OUR CONTRIBUTION TO THE NATION'S WAR EFFORT

A HEALTHY SIGN

BETWEEN February 20th and March 28th, members of the Association have held nearly 30 meetings to consider the draft scheme for the control of some of the major diseases of livestock presented as a basis for discussion with interested bodies. At some of these meetings attendances have actually reached 100 per cent of members of Divisions: at others it has been near 90 per cent—nearly all have been well attended and some Divisions have held two or more meetings. The North of Scotland, North of Ireland, Veterinary Association of Ireland, the Veterinary Research Club and the Association of Veterinary Inspectors are the only Divisions from whom reports have not yet been received, though we understand that some regional meetings of this last-named body have been held.

A study of the reports is very heartening. Almost without exception the meetings have unanimously approved the scheme as a basis for further discussion, and a promise has been given by the President that any agreement reached between the Association and other bodies will be submitted to members for their approval before final acceptance.

None could fail to be profoundly impressed by the views expressed, which reveal the deep sense of responsibility which the profession feels towards agriculture. By common consent it was agreed that this was the moment for our profession to pull its weight in a national effort, though it was realised that this might involve the individual in considerable personal sacrifices both in time and money. Agriculture, we are told, is the first line of defence and we have an indispensable place in that line. To tackle the problem of disease control in dairy herds in war-time, to increase the nation's milk supply, is a team job, requiring the combined efforts of the veterinary profession, the stock owner and the Ministry of Agriculture. For a team job to succeed, the parties must be animated by the team spirit. No task can be accomplished if any action by one party is held suspect by the others: there must be trust and goodwill.

Within the profession we have got unanimity to a degree which is as remarkable as it was unanticipated: agreement is in sight between the Animal Health Division, the Agricultural Research Council and the National Veterinary Medical Association on technical details; considerable progress has been made in discussion on ways and means between the Animal Health Division and this Association. Next week it will be seen how far the stock owners, as represented by the National Farmers' Union, are prepared to co-operate.

It is impossible not to sympathise with the agricultural community in the difficult position in which it finds itself to-day. Starved as the result of decades of parsimonious government action in peace-time, this Cinderella is now expected to be the buxom wet nurse nourishing the nation in time of war. Agriculture has responded in a worthy—indeed, in an almost incredible—manner: it deserves well of the country and we believe that in the difficult post-war period, the part played by this great industry will be remembered.

Improved methods of land husbandry have been insisted upon: improved animal husbandry is the essential corollary if their value to the farmer is not to be vitiated. We believe that by intelligent co-operation between stock owners and their veterinary advisers very much of the present wastage could be either prevented or mitigated. The differences in the types of farming throughout the country are reflected in the wide variations in types of veterinary work — indicating that any scheme adopted must be sufficiently elastic to accommodate itself to all conditions. Perhaps local administration is desirable, but the general consensus of opinion within the profession is that any scheme to be successful must have central control and must receive more than the good wishes of the Ministry of Agriculture.

Reports of the Divisions show that a very large number of the profession are able to undertake immediately the work envisaged in the recommendations agreed upon jointly by the Animal Health Division, the Agricultural Research Council and the N.V.M.A. Among these was a welcome number of whole-time veterinary officers of the Ministry of Agriculture. The most encouraging sign of all was the insistent and unanimous desire of other practitioners for further and immediate tuition: this demand we intend to see satisfied without delay.

If the work of the Survey Committee has done nothing else, it has awakened the profession to a sense of its responsibility and its possibilities. For this alone it deserves and has received the thanks of all—yet its labours are only just begun.

PRACTICAL TRAINING FOR VETERINARY STUDENTS

IN our last issue we published a letter from the Secretary of the Royal College of Veterinary Surgeons appealing to the profession to co-operate with the veterinary colleges in helping to provide for veterinary students better opportunities for seeing practice than are at present available. Practitioners in every generation have complained that the new graduate is sadly deficient in practical knowledge: indeed, the very men who are heard to express with sarcasm their opinion of the young graduate's practical knowledge were themselves the victims of similar gibes when they got their first assistantship. It is not to be expected, however, that the veterinary colleges can provide the experience which would give them a really satisfactory insight into general practice among farm animals. To do that it would be necessary for each of the colleges to run a general practice, and it is to be anticipated that that would not be looked upon with too much favour by the practitioners of the district. The Loveday Report dismisses this idea, but does not, on the other hand, imply any depreciation of the services which may be rendered to students by the practitioners who give them the benefit of their experience and instruct them in the many things essential to the running of a well-ordered practice. The report adds, "This assistance can best be rendered under the system already introduced by the R.C.V.S. whereby each student spends a portion of his time during his clinical period of training with a practitioner who is able to give him his individual attention."

The Loveday Committee's recommendation on the matter is in the following terms: "That a period of not less than six months with a veterinary practitioner, of which at least half should be during the fourth and fifth years, be made compulsory for each student, and that evidence of the fulfilment of this requirement be produced before permission is granted him to sit his final examination."

The Loveday Committee do not, however, explain how this requirement could be made compulsory. On whom would the compulsion fall? It is found as a fact of experience that though there are probably sufficient practitioners in the country to provide all the veterinary students at present in the schools with a satisfactory course of training, yet the number who have agreed to do so, in spite of appeals made to them by the principals of the veterinary colleges and the students themselves, is altogether inadequate. Nevertheless it is difficult to see how any compulsion can be brought to bear on the practitioners. This is a free country and if a member does not want to be bothered with training veterinary students there is no law to compel him to do so.

But in circumstances such as these how can the provision be made compulsory on the veterinary student? He cannot compel a practitioner to take him.

Yet the Loveday Committee are perfectly right, and in perfect agreement with the practitioners themselves, when they say that practical training should be an essential part of the student's education.

The position resolves itself therefore into this, that the practitioners must themselves be willing to come forward and be helpful. Until it is known that there are sufficient practitioners assisting in the scheme to provide the necessary facilities for every student, it will be impossible to compel students to produce evidence of having received such training. It is expected of members of a learned profession, as distinguished from a mere trade or business, that they will hand on the torch to the rising generation.

We would therefore strongly support the appeal made by the Royal College, and we trust that members of the profession will turn again to the letter published in our last issue, read it carefully, and if they can see their way to provide the opportunities for practical training there described, send in their names to the Secretary of the College in order that they may be put on the panel of those willing to serve the profession in this way.

CLINICAL COMMUNICATIONS

Spasm and Induration of the Cervix Uteri in Cattle

J. P. ALLEN POTTS, M.R.C.V.S.
Bishop Auckland

I.—Spasm of the Cervix Uteri

Subject.—A red and white Shorthorn heifer, two and a half years old.

History.—Towards night on a Tuesday the heifer had started to strain. Throughout Wednesday straining occurred at irregular intervals. At 4.30 a.m. on Thursday morning the animal was very restless and excited, and gave evidence of abdominal pain. Two hours later the heifer was straining hard and there was protrusion of the vagina: "a large red mass" was the owner's description.

Examination.—I examined the heifer at 9 a.m. on Thursday and found the *os uteri* contracted, being able to insert only one finger. The cervix was elongated. There was no induration or sign of any alteration in the tissue of the cervix.

Spasm of the cervix was diagnosed and a favourable prognosis given to the owner.

Treatment.—I decided to give the heifer further time before attempting mechanical dilatation, as the animal showed no signs of weakness. A sedative drench (1½oz. chloral hydrate) was administered and on my returning at 5 p.m. that afternoon, the heifer was showing the water-bag. On examination the head of a live calf was easily felt in the passage. The forelegs of the calf were then secured and with gentle traction the calf was safely delivered.

. . . . .

II.—Induration of the Cervix Uteri

Subject.—An Ayrshire cow, five years old.

History.—The cow prepared for calving on the Friday and on Saturday at 6 a.m. the owner found her in evident distress, lying stretched out and straining heavily. Finding no sign of the calf on examination he consulted me at 7.30 a.m.

Examination.—I found it just possible to insert one finger into the *os*. The tissue of the cervix was hard, indurated and deformed. The head and foot of a live calf could be felt pressing above and below the neck of the womb.

Induration of the cervix was diagnosed and an unfavourable prognosis given.

Treatment.—Mechanical dilatation of the *os* (manual and by the use of the uterine dilator) was attempted but proved unsuccessful. As the cow was getting weaker it was decided to perform vaginal hysterotomy.

Operation.—Epidural anaesthesia was induced. The vagina well washed out with warm saline and well lubricated with antiseptic soap. One finger was inserted into the *os* and a blunt-pointed bistoury introduced. A lateral incision was made on each side of the cervix, the bistoury being drawn in an antero-posterior direction. Both hands were then gradually inserted into the *os*, and with gentle pressure outwards, the cervix was dilated. The foetal membranes were punctured and the calf delivered by slow gentle traction. There was very little haemorrhage.

Sequelae.—The calf was alive but required artificial respiration. While this was in progress, prolapse of the uterus occurred in the cow.

The foetal membranes were firmly adherent, so after thorough cleansing both uterus and membranes were returned and four antiseptic pessaries inserted. A sedative drench was given to the cow and a rope truss adjusted. In a short time the cow was in a sitting position and had taken a pail of warm gruel. The rope truss was removed on the Sunday and four more pessaries inserted; by evening the cow had cleansed.

The calf thrived and did well. Unfortunately the cow died in five days, peritonitis supervening.

ABSTRACTS

[MUSTARD GAS AND ARMY ANIMALS. Bamford, R. M. (1940.) *J. R.A.V.C.* **11**. 113.]

The first use of "mustard gas" (dichlor-ethyl sulphide, "yellow cross," "yperite," "lost") is attributed to the German forces around Ypres on the night of July 12th-13th, 1917. Its projection by artillery shell is described and followed by an account of its chemical and physical properties. Although the histopathology of lesions is given in detail it is considered that macroscopic lesions, their recognition and treatment, are of present importance to the A.R.P. worker.

(1) Contamination with Liquid

(*a*) *Skin.*—Erection of hairs of the coat in the vicinity of the drop. Complete in summer in 10 minutes, winter 20 minutes.

Oedema two hours after contamination, attaining maximum in 24 hours and persisting for some days. Local lymphatics swollen and prominent. Exudation of serum.

Necrosis: firmly adherent to deep structures and remaining so for three weeks. Wrinkling then occurs and desquamation is complete by sixth week.

Residual scar: consolidated by eighth week. Hair follicles are destroyed. The central scar is hairless; surrounding hair may lose its pigment. The fine skin of the heel is particularly vulnerable and exhibits swelling, sepsis, skin fissure and intense lameness. The horny hoof is very resistant to contamination.

(*b*) *Eyes.*—The smallest drop of gas causes acute painful conjunctivitis, oedema of eyelids and temporary blindness. In two weeks acute symptoms have passed leaving a facetted cornea. Resolution may need months and is accompanied by a persistent muco-purulent discharge from the conjunctival sac.

(*c*) *Respiratory Tract.*—Oedema, ulceration, necrosis of nasal mucosa; blood-stained nasal discharge. Stenosis of the naso-pharynx, dyspnoea, pneumonia in severe cases.

(*d*) *Digestive Tract.*—Ulceration of the lips and buccal mucosa, vesicles and necrosis. Copious salivation, sometimes blood-stained colic; tenesmus, offensive dysentery.

(2) Contamination with Vapour

The relatively weak action of mustard gas vapour on the skin of the horse (and presumably of the small domestic animals) is due to the action of the air buffer held in the hairs of the coat. Exposure for one hour to a concentration of 1 in 500,000 is not injurious.

Lesions are similar though milder than those caused by droplet contamination, but the eyes are sensitive to vapour and so, to a lesser degree, is the nasal mucosa.

Treatment

The treatment of mustard gas casualties may be classified as follows:—

(1) Decontamination

To be wholly successful this should be practised within a few minutes of contamination. Bleach paste made with equal parts chloride of lime and water is brushed into the coat, avoiding eyes, nostrils and lips. After five minutes this paste is removed by thorough rinsing with cold water. Anti-gas Ointment No. 1 is applied to localised areas only. Anti-gas Ointment No. 2 (chloramine) may also be used for this purpose, but is irritant and must soon be removed with a fat solvent.

(2) Treatment of Established Damage

(*a*) *Skin.*—Weak antiseptic packs or poultices (hydrarg. perchlor. 1 : 1,000, "Eusol") followed later by lavage with hypertonic saline or saturated solutions of sodium sulphate.

(*b*) *Eyes.*—Early stages require irrigation with 2 per cent. solution sodium bicarbonate or normal saline, proceeding to boric acid solution. Eyelids must be prevented from gumming. Serious affections of the cornea and iris with hypopion require a dark box and eyeshades in addition to the routine curative treatments.

(*c*) *Respiratory Tract.*—Nasal douches of warm normal saline and feeding from the floor. Spasms of coughing are best controlled by morphine. Naso-pharyngeal oedema may necessitate tracheotomy but not if the lungs are already involved.

(*d*) *Digestive Tract.*—Routine treatment for enteritis.

Protection against Contamination

If known contaminated areas cannot be avoided the legs should be dressed from the knees and hocks down with Anti-gas Ointment No. 1 before traversing such areas. No watering is allowed from shallow standing water.

In unspecified areas natural cover, barns and stables should be used. Roofs must be erected over standings.

The service rug is proof against penetration for 20 minutes but rubber clothing distresses horses at work. Eye fringes are a useful addition to hoods, the eye-holes of which may be protected with strong cellulose-acetate sheets. Horse respirators or nosebags should be fitted. The protection of the foot has not yet been satisfactorily determined.

Contamination of Fodder

This is determined by the degree of odour about the food and is classified as :—

(*a*) *Light.*—Spread out and expose to air, turning frequently. Remove outside layers of stacked fodder. Grains may be cooked if it is borne in mind that both the water and steam from the process are poisonous.

(*b*) *Heavy.*—Destruction of this fodder is advised.

Contamination of Drinking Water

No danger is to be expected from running streams, but in standing water mustard gas droplets sink to the bottom, leaving a film of gas over the surface.

Excellent photographs are added to this essay, illustrating the effects of the gas on the eye, skin and coronet.

J. P.

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[DIAPHRAGMATIC HERNIA IN EQUINES, NOT OF TRAUMATIC ORIGIN. Trum, B. F. (1939.) *Vet. Bull. Suppl. U.S. Army med. Bull.* **33**. 297-300.]

Two instances of ruptured diaphragm have been discovered on *post-mortem* examination in horses which died after exhibiting symptoms of colic.

A third horse had been treated for colic for 36 hours before passing into the hands of the author. Symptoms were similar to those which had been noticed in one of the two animals which died. Apart from abdominal pain a characteristic feature was acute respiratory distress. Rupture of the diaphragm was suspected. Rectal examination caused no undue straining and nothing abnormal was palpated. Steady traction on a part of the small intestine resulted in a sudden release of tension with an immediate relief of the respiratory distress and all pain. The following day the horse returned to work with no untoward sequel.

C. F.

* * * * *

[CULTIVATION OF CERTAIN VIRUSES USING YOLK OF CHICK EMBRYO AS ROUTE OF INJECTION. Stimpert, F. D. (1939.) *Proc. Soc. Exp. Med. Biol.* 483-485. (3 refs.).]

The yolk sac of the developing chick embryo has recently been used for the cultivation of rickettsiae of Rocky Mountain spotted fever, typhus fever, and both Eastern and Western strains of equine encephalomyelitis. (Cox, H. R., *Publ. Hlth. Reports. U.S.A.* **53**. 2241). The present report summarises successful results obtained by the author with the same medium in the cultivation of the virus of St. Louis encephalitis, and three strains of poliomyelitis.

D. D. O.

NOTES AND NEWS

The Editor will be glad to receive items of professional interest for inclusion in these columns.

PERSONAL

Colonel Graham Rees-Mogg's Appointment as Sheriff

Among the sheriffs appointed by His Majesty the King in Council, at Buckingham Palace on March 26th, for the year 1941, is Veterinary-Lieutenant-Colonel G. B. C. Rees-Mogg, O.B.E., F.R.C.V.S., of Clifford Manor, near Stratford-on-Avon, whose nomination as Sheriff for the County of Warwickshire was recorded in our issue of November 16th, 1940.

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The George Medal has been awarded to a National A.R.P. for Animals Committee worker, Mr. D. H. Currie, of Sheffield, who, toiling for hours amid collapsing ruins at great personal risk with H.E. bombs still falling, was happily successful in releasing a trapped household—man, wife and two children—and a second man.

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BENEVOLENCE

Donations Received in Response to the Appeal made by the Officers of the N.V.M.A.

	£	s.	d.	£	s.	d.
Already acknowledged in *The Veterinary Record* of February 22nd, 1941				637	3	6
Per H. Burrow:						
Bonallo, T. G.	0	10	6			
Burrow, H.	1	0	0			
Cockburn, R. S.	0	10	6			
Crawford, M. E.	0	5	0			
Hughes, L.	1	0	0			
Inglis, C. P.	0	10	0			
Simpson, W.	0	5	0			
Steven, J.	0	10	0			
				4	11	0
Dwerryhouse, W. L.				3	3	0
Per E. P. Edwards:						
Arthur, G. H.	0	10	0			
Aldred, H. H.	1	0	0			
Cane, J.	1	0	0			
Edwards, F. G.	1	0	0			
Hughes, H. Tudor	1	0	0			
Harbour, H. E.	0	10	0			
Lee, R. M.	1	0	0			
Macrae, F.	1	0	0			
McWilliam, J.	1	0	0			
Wilson, T.	1	0	0			
				9	0	0
Per Lancashire Division (second contribution):						
Anderson, T. S.	0	10	0			
Baird, J. C.	0	10	0			
Ball, F. A.	2	2	0			
Bett, W. F.	1	1	0			
Bragg, A. L.	1	1	0			
Brear, N.	2	2	0			
Clayton, N. M.	1	0	0			
Craig, J. F.	5	0	0			
Davies, G. O.	1	1	0			
Dobie, T. A.	1	0	0			
Garside, J. B.	2	0	0			
Greenway, E.	2	2	0			
Hewetson, H. G.	2	2	0			
Hewetson, H. R.	3	3	0			
Holroyd, J.	21	0	0			
Hopkin, F.	5	0	0			
Hughes, R.	1	0	0			
Kelly, Mrs. K. G.	1	0	0			
Lee, R. M.	2	2	0			

	£	s.	d.	£	s.	d.
Leech, F. H.	1	1	0			
Lindsay, P. T.	2	2	0			
Locke, G. H.	2	2	0			
Mattinson, A. B.	0	10	6			
Mayall, G.	1	1	0			
Oddy, R. H.	2	2	0			
Pembrey, C. W.	0	10	0			
Pembrey, H. G.	0	10	0			
Rankin and Leslie	5	5	0			
Rigby, J. R.	1	1	0			
Shawcross, C. F.	1	0	0			
Shirley, G. N.	1	0	0			
Steele-Bodger, H. W. ...	0	10	0			
Sumner, H.	3	3	0			
Sutton, D. O.	0	10	0			
Trevers, C. T.	1	1	0			
Wright, A. J.	1	0	0			
Wright, J. H.	1	0	0			
				80	4	6
Lincolnshire and District Division				20	0	0
Members of Region 7 of Division of Association of Veterinary Inspectors of Ministry of Agriculture				1	19	6
Members of South Wales Division (second contribution)				31	1	0
North Midland Division and Members ...				12	11	0
Society of Veterinary Practitioners (second contribution)				50	0	0
Snodgrass, A.				1	1	0
Total to date				£850	14	6

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R.C.V.S. OBITUARY

Carr, John Herbert, Valetta, York Road, Dun Laoghaire, Co. Dublin. Graduated, Edinburgh, December 13th, 1895. Fellowship, December 7th, 1907. Died March 17th, 1941.

Connochie, Robert H., St. Boswells, Roxburgh. Graduated N. Edinburgh December 23rd, 1899. Died March 23rd, 1941; aged 68 years.

Poulton, Wilfred Frank, C.B.E., M.R.C.V.S., Heathcliff, Mumbles, Glam., late of Kampala, Uganda, and the Mines Department, Harpur Hill, Buxton. Graduated London, December 18th, 1912. Died March 15th, 1941; aged 53 years.

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The Late W. F. Poulton, C.B.E., M.R.C.V.S.

It is with deep regret that we have to announce the death in Mumbles, Glamorganshire, of Mr. W. F. Poulton, C.B.E., former Director of Veterinary Services in Uganda.

Mr. Poulton, who retired nearly five years ago, first went to Uganda in 1914, was on military service until 1918, and rejoined the Veterinary Department after the war. Soon after his appointment as Director of that Department in 1924 he established the Koja Stock Farm, an institution which quickly became an object lesson of the improvements possible in native livestock. He was convinced that a close study of African stock was necessary before importing British bloodstock into Uganda, and his ideas, at first viewed with scepticism, were later proved to be right. Since his retirement he had served with the Safety in Mines Research Board near Buxton.

Mr. Poulton was a fine hockey player, and always took a keen interest in athletics generally; indeed, apart from his devotion to the profession and splendid work carried out during his Colonial service as D.V.S., Veterinary Department, Kampala, Uganda, for which he received well-earned recognition in the form of the C.B.E., W. F. Poulton was one of the finest athletes ever produced by the veterinary profession.

A very close friend writes of him:—

"I have been in close contact with 'Polly'—as he was known to his intimates—throughout the whole of his school days and College career and have never met one more popular with all and sundry for his lovable and cheerful disposition, or more admired in the athletic world for his prowess and modesty.

"His speed on the running track was almost phenomenal, with the result that he swept all before him in all sprint races, both at school, College, and in the London Scottish sports, at the last named of which in 1910 or 1911 he actually beat Applegarth, at that time 100 yards amateur champion, in the splendid time of under 10 seconds. Yet he would not accept an invitation to join the L.A.C. Harriers—where, no doubt, with proper training he would have made a name for himself in the running world—since he had no such ambitions, but just ran for the love of it. Moreover, this wonderful turn of speed combined with a natural aptitude for all ball games, made him a more than useful performer on the rugger and hockey field, where he left his opponents standing. Though I rarely came across him in after-life, I have learnt that he kept up his games during the whole of his career in Uganda, and could still give points to most of the younger generation.

"It is, however, as a most lovable and loyal companion, possessed of irrepressible spirits and intense keenness on whatever he took up, that I chiefly like to remember him."

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Mr. R. H. Connochie, M.R.C.V.S.

Mr. Robert Connochie was in practice in St. Boswells for 34 years. He retired from practice in 1938 and had been in poor health for some time. He was the youngest and last surviving son of the late Mr. W. D. Connochie, M.R.C.V.S., Selkirk, in whose practice he assisted before moving to St. Boswells in 1905. Mr. R. H. Connochie was well known as a veterinary surgeon over a wide district, was specially interested in horses, and his sound judgment and experience was often sought in districts remote from St. Boswells. In his early days he was a keen and successful horseman. A member of the Highland and Agricultural Society, he acted as veterinary surgeon in connection with the Society's Highland Show at Melrose in 1936. Born in Selkirk in 1873, Mr. Connochie was an ex-Standard-Bearer, and deeply interested in all matters connected with his native town. He is survived by his wife and three daughters.

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Mr. John H. Carr, F.R.C.V.S.

Mr. John H. Carr, F.R.C.V.S., whose death occurred suddenly, was Veterinary Officer to Dun Laoghaire Borough Council, and a well-known figure in South Co. Dublin. He was son of Mr. John Carr, who was a prominent member of the old Kingstown Commissioners.

About 1903 he was appointed Veterinary Inspector to the old Dun Laoghaire, Blackrock, and Dalkey Urban Councils, and in 1930 was appointed to the present Council. He was for many years Hon. Veterinary Surgeon to the Leopardstown Racecourse. He had owned "Picture Saint," which won the Irish Cesarewitch in 1919.

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FOOT-AND-MOUTH DISEASE

The spread of foot-and-mouth disease in Eire, where numerous fresh outbreaks have been reported, has become so alarming that an appeal for public co-operation to stamp it out has been made in the Dail by Dr. Ryan, Minister of Agriculture.

Dr. Ryan said that without the fullest co-operation for which he was asking it might not be possible to eliminate the disease. "It may become endemic, with catastrophic results," he said. "We are dealing with a desperate situation, and I appeal to everyone for the fullest measure of co-operation."

. . . . .

Since our last announcement further outbreaks of the disease have been confirmed in Herefordshire, Somersetshire, Yorkshire and counties in the North-west.

A New Order

A new Order, entitled the Foot-and-Mouth Disease (Disinfection of Road Vehicles) Order, prohibits the simultaneous carriage by road vehicles of swill and feeding-stuffs or litter. It also requires all vehicles which have carried swill to be disinfected with a solution of sodium carbonate before being used for other purposes.

* * * * *

PROTEST AGAINST ATTESTED BONUS WITHDRAWAL

Since it has been made public that it is not the intention of the Government to continue beyond a period of three years the bonus applying to herds registered under the Tuberculosis (Attested Herds) Scheme, a great deal of disappointment has been expressed by milk producers whose cattle and milk previously qualified for the premium.

On the recommendation of the Milk Committee, the War Committee of the N.F.U. and Chamber of Agriculture for Scotland have represented that the decision to withdraw the bonus after three years should now be rescinded. "At a time when the milk supply of the country is placed in such an important light, it seems unfortunate that the inducement previously offered for the production of clean, pure milk should be taken away after a limited period. It is therefore to be hoped that the authorities will see their way to reconsider the present proposal."

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HORSE-FEED MIXTURES

The Ministry of Food announces that a general licence authorises the preparation for sale of the following horse-feed mixtures: (*a*) Any mixture of any two or all of (1) oats, (2) beans, (3) bran; (*b*) any mixture of any one or more of the above with chopped hay and/or chopped oat straw. If the mixture includes chopped hay or straw, which are unrationed, the buyer is entitled to a correspondingly greater quantity of the mixture. On the other hand, the total quantity of oats, beans and bran in the mixture supplied must not exceed the quantity permitted by the ration documents surrendered by the buyer.

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MALE INFERTILITY

The following annotation from the *Lancet* of January 11th, although referring to male infertility in the human subject, will undoubtedly be read with interest by veterinary surgeons who are concerned with a similar condition in domesticated animals:—

"Sterility and sub-fertility in the male are complex subjects, entailing exhaustive urological, endocrinological and laboratory studies. Progress made in the last ten years has been well summarised in three articles by H. A. R. Kreutzmann, S. R. Meaker, S. N. Vose and C. W. Charny.* Cases may be divided into two groups: urological and endocrinological. The commonest cause of sterility in the first of these groups is a previous attack of gonorrhoea resulting in bilateral epididymitis, stenosis of the ejaculatory ducts and chronic vesiculitis and prostatitis; more rarely the condition is congenital and due to cryptorchism, hypospadias or abnormal attachment of the epididymis to the testis. Endocrinological causes are, however, responsible for more cases of sterility and sub-fertility than urological, the majority of them being due to hypoplasia of the testis, pituitary dysfunction and hypothyroidism. Examination of the patient must include a careful history, a complete medical overhaul and a somewhat elaborate semen examination. All authorities are now agreed that the quality rather than the quantity of the spermatozoa provides the best index of the patient's fertility. The old idea that a man with a spermatozoon count below 60,000,000 is to all intents and purposes sterile is now abandoned, for there have been many instances of conception with counts much below this figure. It is far more important that the proportion of abnormal spermatozoa should not be above 20 to 25 per cent. Although endocrine disturbances are sometimes found which explain the abnormalities of the semen, more often than not the patients appear healthy, and all examinations—such as that of the metabolic rate—give normal results. Usually pituitary dysfunction is postulated, although no evidence of this can be discovered. Diagnosis is ahead of treatment. Consistently good results follow endocrine therapy only in cases due to hypothyroidism. Kreutzmann found that the administration of testosterone gave no result. Meaker and Vose emphasise the importance of dealing with any chronic infection, since bacterial intoxications have a decided effect on spermatogenesis. Charny describes the technique and discusses the place of testicular biopsy in the investigation of a case of male infertility. He points out that it is a simple innocuous procedure, and that it is not only a definite diagnostic aid in differentiating between obstructive and non-obstructive semen defects but that it is of the greatest value in prognosis. Since we are still in the dark as to the best method of treating these cases, testicular biopsies carried out before and after treatment yield the most direct evidence of the efficiency of the therapeutic agent employed. These papers may help to draw attention to the need for adequate investigation of the husband when marriages are childless."

* *J. Amer. med. Ass.* Oct. 26, 1940.

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WAR DAMAGE INSURANCE FOR ALL

Almost everyone in the country will be affected by the Government measure to which the Royal assent has now been given. This far-reaching war-time insurance scheme is in two parts. Part I, which applies to real property—houses, other buildings and land—is to be administered by a new Governmental body, the War Damage Commission. The Commission is being constituted and an early announcement of its personnel is expected. Part II relates to movable property—plant, machinery, business equipment, farm implements, crops, livestock and produce, furniture, clothing and personal effects. It includes three distinct schemes—one for businesses, another for farmers and a third for householders and other owners of "private chattels." "Businesses," for this purpose, includes manufacturers and traders, professional men and women, local authorities, hospitals, churches, universities, charitable and other institutions.

Responsibility for administering the schemes under Part II will fall upon the Board of Trade, which already administers the war risks commodity insurance scheme. The Board are setting up an Insurance Department to deal with all the insurance work falling upon the Board including that arising from Part II of the War Damage Bill and commodity insurance. The Board will not issue policies directly to policy holders. To avoid a "bottleneck" and enable insurance to be effected in a convenient way, familiar to them, insured persons will obtain their policies through their own brokers or fire insurance companies.

An important feature of the Government's plan is that providing free cover, up to stipulated limits, for householders and others whose furniture, clothing and personal effects are damaged as a consequence of enemy activity. With certain exceptions insurance under the business and farm schemes will be compulsory. Under the private chattels scheme, householders and others who wish to insure beyond the limits of free cover will be able to do so, at favourable rates, up to a total amount of £10,000. Compensation will be paid in respect of damage suffered since the outbreak of war.

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MINISTRY OF AGRICULTURE NEWS SERVICE

Fat Stock in Disease Areas

When Full Price will be Payable.—Fat stock from premises infected by swine fever or sheep scab must be sent direct to the slaughterhouse instead of to a collecting

centre. But the full price, and not the casualty price, will be paid for such fat stock for which the usual twelve days' notice has been given. The stock, however, must be accompanied by a licence issued under the Diseases of Animals Acts; and sheep from a farm infected with scab will have 6d. per sheep deducted to cover the cost of disinfecting the skins and the loss due to inferior skins.

The full price, and not the casualty price, will also be paid for animals slaughtered within two miles of a place infected with foot-and-mouth disease, provided the permission of the Ministry of Agriculture Inspector is obtained and the twelve days' notice given. Healthy pigs removed under a licence from the Ministry's Inspector from premises infected with swine fever will receive the full price and in this case twelve days' notice will not be necessary, but the price for such pigs will be calculated on the weights of the carcases fit for human consumption. No insurance deductions will be made in the case of these pigs.

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Backyard Hens: How to Use Balancer Meal.—Under the livestock rationing scheme poultry keepers with not more than 12 birds may purchase from poultry food merchants, with whom they are registered, a mixture known by the trade name of "Balancer Meal." This special poultry feeding compound is not in itself a complete or balanced ration, but is designed for mixture with household waste. Each bird should be given a daily ration of about one half-pint of cooked waste plus 2½ oz. of "Balancer Meal."

If "Balancer Meal" is fed alone or in excess of the quantity given above it will not only be wasteful but may possibly prove harmful to the birds. It also means that users may experience a shortage before the end of the rationing period. A good plan is to measure out the "Balancer Meal" to ensure even distribution over the whole rationing period. A one half-pint glass will hold approximately 4½ oz. of meal. If some other kind of measure is used the weight of the meal it will hold must first be ascertained.

The household waste to be used with the meal should be prepared on the following lines: Stale crusts and similar material are best dealt with by baking in an oven, after which it may be crumbled to form a dry meal. On the other hand, vegetable, fruit, meat and fish waste require mincing and boiling in a minimum of water. The cooked waste, both boiled and baked, is then mixed with the dry "Balancer Meal."

One of the first principles of good management is to feed the birds at regular times. Birds may be given two feeds daily, one in the morning and one in the afternoon. In cold weather the mash may be fed warm. Green vegetables of all kinds, when available, form an excellent addition to the ration. They may be given at mid-day and hung up inside the house or run in such a way that birds in reaching for them will obtain exercise.

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Straw for Paper.—Paper makers are turning more and more to home-grown straw to take the place of imported esparto grass in the manufacture of their product. Wheat or oat straw suits them best, but barley straw can be used. There should be more than enough straw in the country to meet all the needs of the paper trade on the present basis without encroaching upon agricultural requirements. The N.F.U. have now made arrangements with the Paper Makers Straw Trading Co., Ltd., for a fixed price for first quality straw baled on the farm. This price will be 70s. per ton, except in certain East Anglian counties, where it will be 65s. It is said that the paper trade will want about 250,000 tons of straw a year, from which 75,000 to 80,000 tons of paper can be made. This quantity is equivalent to about 80,000 tons of wood pulp and it will thus save much shipping space, as well as £1,500,000 in currency.

Thirty pigs have been slaughtered because of suspected swine fever among Tottenham municipal pigs kept in a public park. The suspected pig was bought only recently for breeding.

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A new Order having the general effect of prohibiting the feeding of home-grown wheat to livestock is now in operation.

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The new St. Pancras Rehousing Centre, at the Royal Veterinary College, Royal College Street, which can accommodate 1,000 bombed-out people, was opened on March 28th by Mr. Ernest Brown, Minister of Health.

CORRESPONDENCE

Letters to the Editor should reach the Office not later than by the first post on Tuesday morning for insertion in following Saturday's issue.

The views expressed in letters addressed to the Editor represent the personal view of the writer only and must not be taken as expressing the opinion or having received the approval of the N.V.M.A.

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SIR JOHN M'FADYEAN

To the Editor of the Veterinary Record

Sir,—No son of my father's could but be moved by the tributes paid to his memory in your columns, and I crave the opportunity to express, on behalf of my sisters and brothers as well as myself, our pride and gratitude.

May I add something? My excuse, if one is required, is the quoted remark "I wonder whether anyone outside his family circle ever knew Sir John M'Fadyean," which encourages me to fill in a picture which was inevitably incomplete; inevitably, in its concentration on his professional life it emphasised my father's austerity and apparent grimness, but there was a gayer side with which his family and few intimate friends were familiar.

He had the natural reserve of a Scottish nature, and it was intensified, as it is so often in people of his race, by a singleness of purpose—the *perfervidum ingenium Scotorum*—and by an intensity of feeling which would not and could not betray itself. But his protective armour was no proof, in a mellow old age, against the discerning affection of his grandchildren.

I can hardly remember the sound of my father's laugh, and family tradition has it that when he saw "Charley's Aunt" he laughed just once. On the other hand I can hardly think of him without seeing a smile on his lips and a twinkle in his eye. I remember his recounting with glee in the family circle, how, on some ceremonial occasion or other, a speaker in his honour observed that while he was never known to smile those who knew him were aware of the heart of gold concealed beneath a stern and forbidding exterior. "If he had looked at me at that moment," said my father, "he might have seen a vestige of a smile for the first time." And the last time I saw him alive and conscious he had strength enough to joke about himself.

May I add one word more? My father's early reading and training were necessarily one-sided, but I always had the impression that his mental gifts would have carried him to success in any profession to which he had felt called. As a small boy I thought that he had missed his vocation through failure to practise at the criminal bar! In my own student days, when I was working at very different material from his own, he frequently took up and read my text-books, and in his old age he found much enjoyment in the Loeb edition of the Classics. Above all he was a Scot, with a passionate love of his native land and its scenery, which is often stern and wild, but always clutches at the hearts of its children.

Yours faithfully,
Andrew M'Fadyean.

3, St. Helen's Place,
London, E.C.3.
March 31st, 1941.